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ISHMAEL: In-situ Sample Handling Modular Analytical Experimental Laboratory

In-Situ instruments are an integral part of mission designs for exploration of planetary surfaces. Analysis of surface samples is required to examine issues of detailed mineralogy and structure, biosignatures, and weathering. In turn, this scientific program demands a landed instrument that can acquire, manipulate and analyze samples with a suite of *in-situ* technologies. A technology gap exists today between sample acquisition and sample analysis tools. Integrated science payload packages need an integrated sample handling system as an interface between sample acquisition front end and analytical science payload.

We are developing a set of modular, rapid prototyping components for sample manipulation that can be easily reconfigured for specific instrument arrays and requirements. There are many candidate technologies that need considerable development to meet the array of instrument need. One approach is to transport and manipulate samples from a few microns up to ~100 microns in diameter by a carrier gas or fluid contained in microfluidic manifold of channels. The building blocks will consist of valves, sample channel interconnects, inlet ports, interlocks to instruments, pumps, sample splitters, active gates and sorters, bi-directional channels and areas that can be optically interrogated.

Our tinker toy set will consist of passive and active components. The passives are the basics of particle flow manifold. The desired technology is easily stackable in three dimensions and can be built into complex distribution geometries to service many instruments without costly redesign for each instrument package.

The active components will allow for sample sorting, gating and immobilization. We will use dielectrophoretic technology to manipulate solid particles entrained in liquid flow. Originally developed for cell manipulation in microbiology, it is based on inducing an electric dipole on a cell (particle) with high frequency electromagnetic fields and then manipulating the cell by steering the dipole with electric fields. Certain science tasks can be performed by the sample handling system itself or in combination with other instruments, such as dielectric spectroscopy or microscopic analysis of caged particles.

We will demonstrate the manipulation of Mars soil analog particles by a dielectrophoretic chip. The system is capable of particle size sorting, concentration, diverting and stream alignment.